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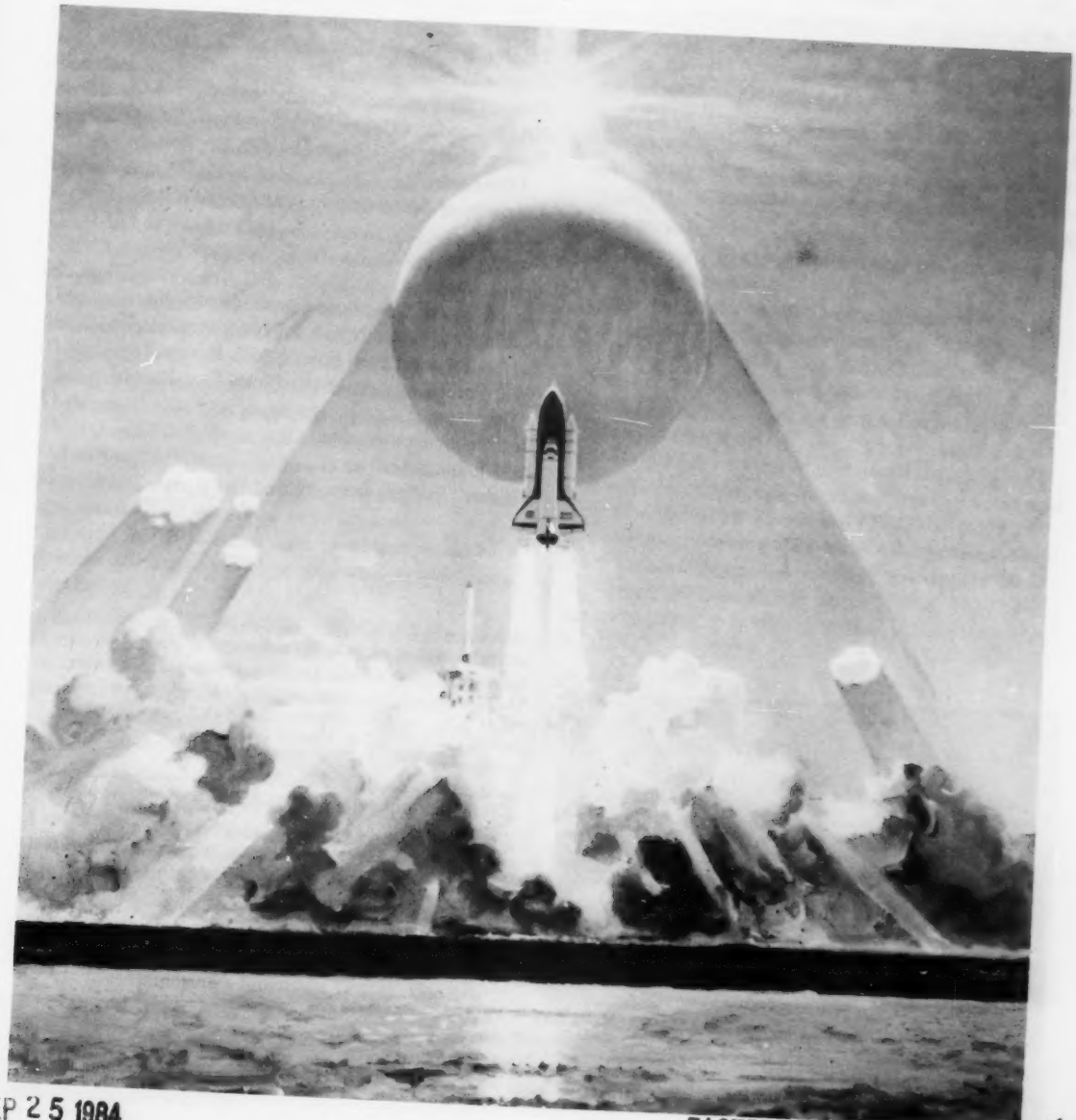

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About the Cover

"Threshold," an acrylic painting by Robert T. McCall, symbolizes through the Space Shuttle Challenger, the rapid rush of technology as the spacecraft roars from the pad and for a moment is poised on the threshold of new worlds.

As a member of the NASA art team, McCall covered the STS-7 launch on June 18, 1983, at Kennedy Space Center, Fla.

The NASA Art Program was instituted in 1962 with the goal of collecting a unique documentation of America's advance into space and providing a special contribution to the history of American art. Nationally known artists are invited to visit NASA sites and record their perceptions in drawings and paintings, which are then donated to the government. Each artist's personal vision of an event is conveyed in his or her particular style and becomes a part of this documentary history of the space age.

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Airborne Science and Applications Program Marks 20th Anniversary

On July 13, NASA's Airborne Science and Applications Program celebrated its 20th anniversary of contribution to the advancement of science. This year also marks the 10th anniversary of one of the program's most significant projects, the Gerard P. Kuiper Airborne Observatory.

The Airborne Science and Applications Program consists of a fleet of high and medium altitude airborne research platforms serving a variety of scientific purposes. They obtain astronomical, earth resource, atmospheric, oceanic and biological data, and they test materials and equipment for NASA's space investigations programs. They also provide verifying information for various earth satellites.

The Kuiper Airborne Observatory is perhaps the best known of the Airborne Science and Applications Programs. A highly modified version of the Lockheed C-141 military cargo transport aircraft, it carries a 36-inch diameter infrared telescope dedicated to astronomical research. The Kuiper Observatory C-141 is a medium altitude aircraft. It makes observations from altitudes between 37,000 and 45,000 feet.

The program's other medium altitude aircraft include a Learjet, a Convair 990 named Galileo II, and a Lockheed C-130. The program's high altitude aircraft, the U-2 and ER-2, fly at 70,000 feet.

The Kuiper Observatory flies at an altitude that puts it above most of the water vapor in the earth's atmosphere. This allows for more accurate measurements of radiation from space than would be possible with atmospherically obstructed, ground-based telescopes.

In the last decade the Kuiper Observatory has provided valuable information on planetary atmospheres, stellar formation and evolution and conditions in other galaxies. Its major accomplishments include verification of a source of infrared radiation at the center of the Milky Way, discovery of rings around Uranus and discovery of a heat source within Neptune.

The observatory also has been involved in the study of molecular species and has identified almost 30 in our solar system alone. Prior to the observatory's first flight, only five were known. The Kuiper Observatory has also identified more than 40 molecular species in various regions of our galaxy.

Another important observatory is the Airborne Science and Applications Program's Learjet. Its observations concentrate on life sciences and astronomy. Among its major accomplishments are the discovery of sulphuric acid in the atmosphere of Venus, measurement of water vapor in the atmosphere of Mars and measurement of heat on Jupiter and Saturn. The Learjet's studies of low altitude wind shear in our own atmosphere are helping pilots to fly more safely.

The Lockheed C-130 airborne observation platform is the lowest-flying of the Airborne Science and Applications Program planes. It's maximum flight altitude is 25,000 feet. A higher altitude is not desirable, since the C-130 primarily studies earth resources, such as agriculture, meteorology and geology. The C-130's sophisticated mapping equipment investigates crops, soils and non-renewable resources.

The program's Convair-990/Galileo II aircraft has participated in many important international atmospheric and weather research and astronomical observation programs. It is the fastest aircraft in the NASA fleet.

The Galileo II accommodates up to 35 on-board researchers, which allows for many different experiments to be carried out on each flight. Its use in international cooperative studies helps scientists from all over the world better understand how our planet and atmosphere interact.

The Galileo II's recent accomplishments include exploration into the origin of monsoons in India, investigation into air-ice-ocean interaction off the northern coast of Greenland and study of global atmospheric effects from the eruption of Mexican volcano El Chichon.

Airborne Science and Applications Program's high-flying observatories, two Lockheed U-2's and their upgraded version, the Lockheed ER-2, also study atmospherics, oceanography and Earth resources. They have been instrumental in verifying observations made by various satellites and the Space Shuttle. They have tested and demonstrated new remote sensing techniques,

NASA's high-altitude U-2 aircraft.

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and they have provided information for earth resource programs.

The U-2s and ER-2 also collect data for atmospheric sampling and disaster assessment. One U-2 was used to measure ash cloud dispersement following the May 1980 eruption of Mt. St. Helens. In addition, the three high flying observatories carry out severe storm measurement and observations to aid in our understanding of the weather.

Hughes Aircraft Nominates Payload Specialists for Shuttle Flights

Two civilian engineers from Hughes Communications, Inc., Los Angeles, will fly aboard the Space Shuttle next year as part of NASA's commercial payload specialist program. The two individuals will be on flights that will deploy the firm's Leasat communications satellites.

Hughes has nominated two payload specialists and two alternates for Shuttle flight 51-D in March and flight 51-I in August 1985. A total of four of the Leasat (Syncom IV) satellites will be flown.

Selected as payload specialist candidates are Gregory Jarvis of Hermosa Beach, Calif., and Dr. John Harrison Konrad of El Segundo, Calif., both employees of Hughes Aircraft Co. Space and Communications Group.

Jarvis was a member of the Leasat design and engineering team and managed the integration and test team for the Leasat program. He has been with Hughes for 11 years.

Konrad has been a Hughes employee for eight years. He has been involved with the Intelsat 6 and Telstar 3 programs. Konrad was also a member of the system engineering team for the Shuttle-launched Anik and SBS satellite programs.

The two alternates selected are L. William Butterworth of Rolling Hills Estates, Calif., and Dr. Steven Lee Cunningham of Altadena, Calif. Butterworth is presently assistant program manager of the Galileo Probe Program. Cunningham is manager of the Space and Communications Group's Systems Analysis Department.

The two engineers selected for the flights will undergo NASA training for about nine months, but remain employees of Hughes.

The Leasat program provides dedicated data and voice communications to U.S. Armed Forces mobile units. The system, owned by Hughes Communications, Inc., is operated on a long-term lease basis with the U.S. Navy.

Former Deputy Administrator George M. Low Dies

George M. Low, former Deputy Administrator of NASA, died of cancer July 17. Low left NASA in 1976 to accept the presidency of Rensselaer Polytechnic Institute in Troy, N.Y.

An aeronautical engineer, Low devoted most of his career to the government's aeronautical and space programs. He began his career as a research scientist at the Lewis Research Center of the National Advisory Committee for Aeronautics in Cleveland, specializing in the fields of heat transfer, boundary layer flows and internal aerodynamics.

When NASA was organized in October 1958, Low was named Chief of Manned Space Flight. At NASA Headquarters in Washington, he was responsible for the Mercury and Gemini programs and was chairman of the special committee that formulated the original plans for the Apollo manned lunar landing. He became more directly involved with manned space flight operations when he was named Deputy Director of NASA's Manned Spacecraft Center (now Johnson Space Center) in Houston in 1964.

Following the Apollo fire in January 1967, Low was asked to direct personally the Apollo Spacecraft Program to supervise the rebuilding of the vehicle and to assure its flight worthiness. He played a leading role in planning and executing all of the Apollo missions and originated the plans for Apollo 8, the first manned lunar orbit flight. During the time Low directed the program, five manned missions were flown, including Apollo 11 in July 1969, the first manned lunar landing.

Low was appointed NASA Deputy Administrator in November 1969. From 1970 to May 1971 he served as Acting Administrator of NASA.

Born in Vienna, Austria, in June 1926, Low became a naturalized citizen in 1945 while serving in the U.S. Army. He received a bachelor's degree in 1948 and a master's degree in 1950 in aeronautical engineering from Rensselaer, and an honorary doctorate in engineering in 1969.

Low was a Fellow of the American Institute of Aeronautics and Astronautics (AIAA), the American Academy of Arts and Sciences and in the American Astronautical Society (AAS); a member of the National Academy of Engineering, of Sigma Xi, Sigma Gamma

Tau, and Tau Beta Pi Honor Societies and a Trustee of Rensselaer. He was a member of the Board of Directors of the General Electric Co. and was Vice President of the Association of Colleges and Universities in the State of New York.

Low's many honors included NASA's Outstanding Leadership Medal, NASA's Distinguished Service Medals twice, the Arthur S. Flemming Award as one of the 10 outstanding young men in government, the AAS Space Flight Award, the Louis W. Hill Space Transportation Award from AIAA and the National Space Club's Astronautics Engineer Award. In 1973, he received the National Space Club's Robert H. Goddard Memorial Trophy and the National Civil Service League's Career Service Award for Sustained Excellence. He was scheduled to receive the Medal of Freedom, the nation's highest award to a civilian, later this year.

First Space Product Set to be Developed for Commercial Use

Microscopic latex particles produced aboard NASA's Space Shuttle should soon become the first space product to be offered commercially.

A major step in the process to put the material on the market was taken in July when 15 grams of the 10-micrometer particles were presented by NASA to the Commerce Department's National Bureau of Standards (NBS). NBS will certify the particles as a "standard reference material" and make them available for sale in early 1985.

The presentation was made by representatives from NASA Headquarters, the Marshall Space Flight Center in Huntsville, Ala., and Lehigh University in Bethlehem, Pa.

The 10-micrometer particles were produced in space during 1983 in the Marshall-developed Monodisperse Latex Reactor experiment. The experiment, conducted jointly under the direction of Dr. John Vanderhoff of Lehigh University, produced quantities of monodisperse (identical-sized) latex microspheres superior to those produced on earth because of the influence of gravity during ground-based manufacturing process.

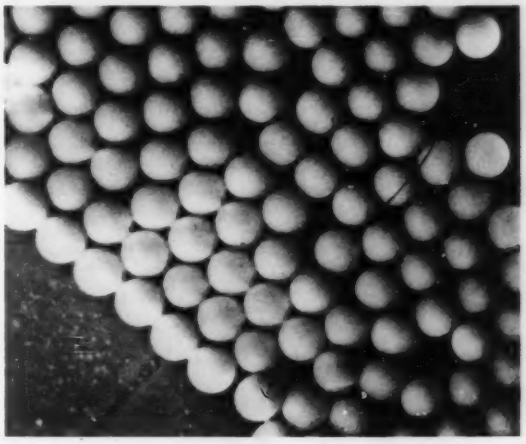
Because of their spherical uniformity and precision, the particles will be used by industry and medical research as a standard for calibrating sensitive scientific instruments as well as in industrial processes.

About 600 units of the latex material will be sold. Each unit, a 5-milliliter vial containing approximately 15 million identical-sized spheres suspended in water, will cost about $400. The proceeds will be shared equally by NASA and NBS to recover the costs of producing and certifying the spheres.

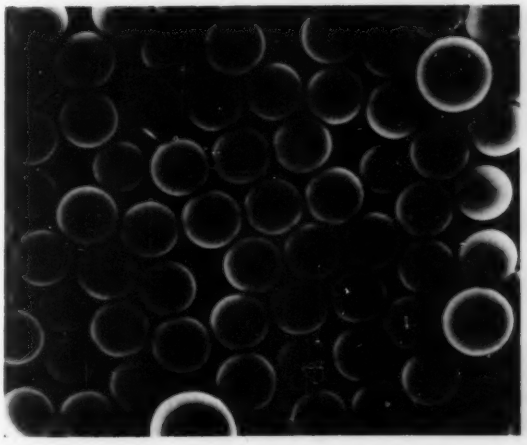
Preliminary samples of the particles have already undergone extensive testing by NBS to evaluate the material's use as a standard reference material at the 10-micrometer diameter range.

The particles will be a new, small-particle primary length measurement standard for use in calibrating instruments and measuring devices. The latex spheres will be the third small particle reference material available from NBS.

Such latex particles have been used in medical research in applications such as measuring the size of pores in the wall of the human intestine in cancer



Space-produced, 10-micron latex particles, from the batch to be offered commercially later this year by the National Bureau of Standards, are identical. Below, using the same chemical recipe and identical experiment hardware, the particles made on earth under the influence of gravity are deformed, off-sized or show other imperfections.



Dr. John W. Vanderhoff, principal investigator for the Monodisperse Latex Reactor experiment, cradles the first batch of latex particles produced during the STS-3 mission in March 1982. Looking on are investigative team members (from the left) Dr. Fortunato J. Micale of Lehigh University, Dale M. Kornfeld of Marshall Space Flight Center and Dr Mohamed S. El-Aasser of Lehigh.

research, and measuring the size of pores in the human eye in glaucoma research.

The latex reactor experiment has been conducted in space on five Shuttle missions beginning in March 1982. It operates in the Shuttle crew cabin with minimum astronaut support. The maximum size of the latex particles that can be produced in quantity on earth, given required standards of quality and uniformity, is about five micrometers. In space, the experiment has produced particles in a variety of sizes ranging from 5 to 30 micrometers.

The experiment, which last flew on Shuttle mission 41-B in February, will continue operations on three subsequent flights to provide particles in larger sizes up to 100 micrometers.

The experiment package consists of four 1-foot-tall chemical reactors, each containing 100 milliliters of a chemical latex forming recipe, housed in a 2-foot-high metal cylinder. The recipe consists of tiny latex beads suspended in water with other chemicals that cause the beads to "grow" larger. The experiment, which incorporated the first controlled heterogenous chemical reaction conducted in space, confirmed the theory that a chemical reaction takes place at the same rate in space as on earth.

Working with Vanderhoff as co-investigators will be Drs. Fortunato J. Micale and Mohamed S. El-Aasser, also of Lehigh, and Dale M. Kornfeld of the Marshall Center.

IRAS Identifies Additional Stars With Possible Solar Systems

More than 40 nearby stars show excess infrared emission similar to that discovered last year around the star Vega (Alpha Lyrae), according to recently analyzed results from the Infrared Astronomical Satellite (IRAS) mission, a joint project of the United States, The Netherlands and the United Kingdom.

Vega — Alpha Lyrae and later, Fomalhaut — Alpha Piscis Austrini were each found to be orbited by solid material, probably in the form of small grains. The new discovery of dozens of other nearby stars sharing infrared characteristics similar to Vega and Fomalhaut suggests that stars orbited by solid material — which may evolve into planets — may occur ordinarily in our galaxy, the Milky Way.

Further study of the 40-some stars will be required, however, to determine if the excess infrared means that solid, orbiting material is present.

IRAS science team member Dr. Hartmut H. Aumann of NASA's Jet Propulsion Laboratory, Pasadena, Calif., examined IRAS observations of 335 visually identified stars within 75 light years of earth and found that more than 40 of them have infrared characteristics similar to those of Vega — an excess of infrared radiation in the 25 to 100 micron-wavelength region of the spectrum. Aumann emphasized that IRAS has not detected any individual planets around these stars.

He reported the new findings at a recent meeting of the American Astronomical Society in Baltimore, Md. "The observational evidence that many dwarf stars show infrared excess similar to Vega is clear," Aumann said. "We are dealing with a phenomenon shared by a significant fraction of the dwarf stars in the neighborhood of the sun" within our galaxy. "What is not clear and what requires a lot more study is how to interpret what we are seeing," he added.

Besides orbiting solid material, the infrared excess around the stars could be due to any of several possibilities, including mass loss from the star or the presence of a previously undetected cool stellar companion. While these mechanisms were ruled out in the case of Vega, additional study of each candidate star will be rquired to determine whether the excess comes from orbiting solid material.

Like Vega and Fomalhaut, the stars are relatively bright main sequence dwarfs. However, unlike those two A-type stars (hot, young and luminous), most of the 40 stars are of F- and G-type. This makes them more similar to the sun, a G-type dwarf star, in terms of luminosity, mass and lifetime. The actual number of stars within 75 light years which exhibit excess infrared emission is most likely significantly higher than the 40 observed, because a large number of nearby stars are too faint to be detected by IRAS.

Studies of Vega and stars that share its infrared characteristics will help scientists to understand how planetary systems form and to determine which stars are likely to possess planetary systems in advanced stages of evolution. Dust and debris-type materials are detected relatively easily by IRAS. Fully formed planets around stars are much more difficult to detect, however, because they have far smaller surface areas than a shell or disk of particles. For an analagous reason, Saturn's moons are visually less apparent than its rings.

IRAS was launched into a polar orbit by NASA Jan. 25, 1983, from Vandenberg Air Force Base in California. The orbiting telescope mapped 98 percent of the sky during the 10-month mission, measuring the infrared emission and location of more than 250,000 stars, galaxies, clouds of dust and gas and other celestial objects.

IRAS is a joint project of NASA, The Netherlands Space Agency (NIVR) and the United Kingdom's Science and Engineering Research Council. NASA's JPL is the management center for the project.

NASA Centers Assigned Space Station Studies

Four NASA centers will participate in definition and preliminary design studies of the Space Station which President Reagan directed NASA to develop in his States of the Union message in January.

The agency is considering a number of alternative Space Station design concepts and the purpose of the definition and preliminary design activity is to narrow to single concept.

Johnson Space Center, Houston, was named earlier this year as the lead center for the Space Station program. The lead center is responsible for overall systems engineering for the program, the selection of a configuration and the integration of all elements into an operating system which is responsive to the customer needs.

Marshall Space Flight Center, Huntsville, Ala., will be responsible for definition of the pressurized Space Station modules which will be built and equipped with appropriate systems for their use as laboratories, as the ward room and galley and for logistic transport. Development of this single "common" module design,

with provisions for data distribution, power, environmental control, thermal control and communications systems to be used in all pressurized areas in the station, will provide for significant savings in the overall program.

Marshall also will manage the environmental control and propulsive systems of the station, the Space Station configuration of a propulsion vehicle (orbital maneuvering vehicle), which will be used to maneuver between the Space Station and other spacecraft, and will define and plan for equipping one of the common modules as a laboratory and an additional two or three modules as logistics modules.

Johnson, in addition to its lead center role, will be responsible for the definition of the structural framework to which the various elements of the Space Station will be attached and for the integration and installation of systems onto this structure. The center also will be responsible for the interfaces between the Space Station and the Space Shuttle and for mechanisms such as the Remote Manipulator Systems, which will be required during assembly of the station in orbit. Johnson also will manage the attitude control, thermal control, communications and data management systems, and the equipping of a common module for crew use as a ward room and galley.

Lewis Research Center, Cleveland, will be responsible for the definition of the electrical power generation, conditioning and storage systems. Although most of the current Space Station studies have focused on large solar arrays as the probable power generation system, Lewis will also examine and evaluate a number of alternative systems for electric power generation, conditioning and storage.

Goddard Space Flight Center, Greenbelt, Md., will be responsible for definition of the automated free-flying platforms which are part of the overall Space Station program and for provisions to service, maintain and repair these platforms as well as other free-flying spacecraft. Goddard also will define the provisions for instruments and payloads to be attached externally to the pressurized sections of the Space Station and also will be responsible for definition of the pressurized modules as a laboratory.

Other NASA centers will support the definition and design activities particularly in technology areas. The Kennedy Space Center, Fla., will, of course be responsible for pre-flight and launch operations and will be involved in logistic support activities.

NASA is planning to release a Request for Proposal to industry later this summer which will lead to the award of competing contracts with the four centers for the definition/design activities listed above. Award of the contracts is expected early in 1985.

During the definition phase, NASA will continue negotiations with several other nations to determine means of international cooperation in the development and use of the Space Station. At the completion of the definition period agreements will be concluded with international partners on the role they will play in the development of the Space Station.

Improved Welding System Introduced

An improved computer-aided welding system is being introduced in the processing of Space Shuttle external tanks to increase the quality of the weld, improve production time and reduce costs, according to William Wilson of the Marshall Space Flight Center, Huntsville, Ala.

The system — variable polarity plasma arc welding — is being incorporated into the operations at Marshall's Michoud Assembly Facility at New Orleans in a joint cost reduction program between NASA and Martin Marietta Corp., builder of the tanks.

By 1986, an initial investment of $20 million to improve the external tank production systems, which includes the variable polarity plasma arc welding process, is expected to produce savings of an estimated $350 million.

The plasma arc technique, first tested in private industry in the mid-1960s as an alternative to more conventional welding, provides higher heat at the point of the weld. The higher heat is generated because plasma arc uses an ionized gas as an energy transport mechanism.

Variable polarity plasma arc welding refines and controls the ability of plasma arc to cut metal and employs a reverse polarity cycle to clean the metal of impurities during the welding operation.

The computer-aided system first melts a key hole through the metal, then "pushes" or continues to burn the hole along the weld line. The molten metal fills in behind the key hole forming a weld essentially free of defects.

Out of every 23 millisecond period of the welding operation, the polarity of the metal surface is reversed for four milliseconds, removing impurities in the path of the weld.

Marshall engineers combined the benefits of variable polarity plasma arc welding with a computer-controlled system to provide a more consistent quality weld. X-rays of the plasma arc weld show an absence of porosity and internal defects in the metal.

"It is a near impossible task for individual workmen to continuously weld the huge external tank on a high production basis because of the varying shape of the tank and varying thickness of the tank walls," Wilson said. "The computer can direct a continuous input which adjusts to the various contour and structural variations of the tank."

The first computer-controlled weld stations were implemented at Michoud with the thirteenth external tank. By October 1986, 16 different welding stations are planned to be equipped with the new system.

With Marshall and Martin Marietta working jointly as the development team on the computer-aided welding system and in making other improvements in the external tank production, significant cost savings have been realized, according to Porter Bridwell, manager of Marshall's External Tank Project Office.

"In 1979 the External Tank Project Office, in conjunction with the contractor, made a commitment to reduce the cost of the first 60 external tanks by $66 million based on a one-time investment of $20 million," said Bridwell.

In addition to the enhanced welding system, the total effort to reduce costs in external tank production by the estimated $350 million covers all aspects of processing, improvements in materials and production procedures, Bridwell added.

The application of advanced technology to a basic industrial operation has also elevated the welding to a higher level, said Wilson. "To some, welding is normally considered an art, but this project with it's computer controls make it a science."

Teacher Workshops Held at NASA Centers

NASA this summer hosted workshops for 300 pre-college teachers of science and mathematics. The two-week program, NASA Educational Workshops for Mathematics and Science Teachers (NEWMAST), was sponsored by the National Association of Science Teachers (NSTA), the University of Toledo, Ohio, the National Science Foundation (NSF) and NASA.

The goal of this program is to recognize teachers' excellence in pre-college mathematics and science teaching and to provide a program for updating science and mathematics backgrounds.

The NEWMAST workshops were conducted with 25 teachers at each of these NASA Centers: Ames Research Center, Mountain View, Calif.; Jet Propulsion Laboratory, Pasadena, Calif.; Johnson Space Center, Houston; Marshall Space Flight Center, Huntsville, Ala.; John F. Kennedy Space Center, Fla.; Langley Research Center, Hampton, Va.; Lewis Research Center, Cleveland; Goddard Space Flight Center, Greenbelt, Md.

The candidates for the program were selected from recommendations submitted by a steering committee consisting of the National Science Supervisors Association (NSSA) and the Council of State Science Supervisors (CSSS), both affiliates of the National Science Teachers Association (NSTA) and the National Council of Supervisors of Mathematics (NCSM), an affiliate of the National Council of Teachers of Mathematics (NCTM).

Workshops at each NASA center directly involved the teachers with scientists and engineers at selected work areas or research and development sites within the center. The teacher participants were informed of the latest research activities and development programs.

During the workshop, opportunities were provided for the teachers to:

- Review and discuss educational resource materials available from NASA including printed materials, video tapes, laser discs, computer programs, audio tapes, movies and slides.
- Identify and recommend space science topics for science and mathematics curricula at the pre-college level.
- Design laboratory activities for existing science and mathematics courses at the pre-college level.
- Organize and prepare materials for public awareness programs for presentation to school and community groups.
- Recommend new educational resource materials for pre-college science and mathematics classrooms to be developed by NASA.
- Recommend ways in which the Shuttle program activities can be integrated into science and mathematics classrooms at the pre-college level.

The NASA centers provide ideal sites for the Honors Workshops. Each center offers a unique variety of opportunities for the teacher participants to become associated with scientists, engineers and technologists working on state-of-the-art research and developments in numerous space technologies.

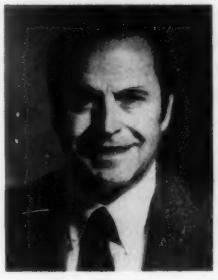
The teacher participants are encouraged to arrange for academic credit through a college or university of their choice. It is anticipated that two to four hours of graduate credit will be awarded to each participant depending on the policies and practices of the institution granting the credit. The College of Education and Allied Professions, The University of Toledo, will offer the participants graduate credit at their request.

Awards Corner

David R. Hedgley, a research mathematician at Ames Research Center's Dryden Flight Research Facility, Edwards, Calif., has been awarded the agency's Space Act Award for the major computer graphics breakthrough he developed. The breakthrough, already in wide use by industry, government and universities, is a code which allows a wide variety of computers to portray three-dimensional shapes. The code solves what computer graphic experts call the "hidden-line" problem in which the computer depicts both visible and hidden lines in X-ray or transparent views of three-dimensional objects, resulting in a cluttered, confusing image. The solution eliminates the hidden lines, achieving greater clarity. Earlier solutions often required inordinately long execution times and had limited applications. The Hedgley solution is general, very fast and applicable even in complex three-dimensional scenes. Hedgley's award was accompanied by a check for $7,500, the largest award ever granted to a Dryden employee in the history of NASA's Space Act Awards program.

Dr. Yahya Rahmat-Samii of NASA's Jet Propulsion Laboratory, Pasadena, Calif., has been selected as the Henry George Booker Fellow to the 21st General Assembly of the Union of Radio Science International (URSI) to be held in Florence, Italy, in late August and early September. The fellowship, granted only every third year, was established in honor of Professor Booker and provides reimbursement for expenses in attending the Assembly. With JPL since 1978, Rahmat-Samii has been active in the analysis, design and measurement of advanced antennas for satellite communications, large space systems and mathematical and computer modeling.

NASA's **Langley Research Center,** Hampton, Va., received the National Interagency Coordination Group on Lightning and Static Electricity award for "Outstanding Contribution for Lightning Characterization and Aircraft/Lightning Hazards Definition." The award was presented in June at the 1984 International Aerospace and Ground Conference on Lightning and Static Electricity in Orlando, Fla. Presented annually for technical contributions for research in the area of lightning hazards to aircraft and related electromagnetic compatibility, Langley was recognized for its efforts in direct-strike lightning research, using a specially instrumented F-106B airplane.



Dr. Burton I. Edelson, Associate Administrator for Space Science and Applications at NASA Headquarters, Washington, D.C., has been awarded the 1984 Wilbur L. Cross Medal for "contributions to science and engineering." The award was presented to Edelson at special ceremonies during Yale University's commencement in May. Named in memory of the Yale dean who went on to become Governor of Connecticut in the 1930s, the Cross Medals are presented annually to distinguished alumni of the Graduate School. Edelson received his Ph.D. in engineering from Yale in 1960.

Finalists Chosen in Shuttle Student Project

Ten finalists have been selected in the fourth competition of the National Shuttle Student Involvement Program, a joint venture of NASA and the National Science Teachers Association.

Objective of the program is to stimulate the study of science and engineering in grades 9 through 12, a competition to develop experiments suitable for flight aboard the Space Shuttle. To date nine student experiments have been flown on the Shuttle.

Finalists were chosen from 200 semifinal entries based on individual scientific or engineering merit for potential assignment on future Space Shuttle flights.

NASA will pair each student with a corporate sponsor and a NASA scientist or engineer to work with the student to determine the feasibility of developing the proposals into an actual experiment for flight.

For those proposals determined to be feasible for flight a development schedule will be established. For those proposals which are not suitable, NASA will attempt to assign the student to work with a principal investigator as part of an existing research team on a project in the student's field of interest.

Interdisciplinary teams of teachers, scientists and engineers reviewed almost 3,000 proposals submitted to

10 regional offices and selected semifinalists. Regional conferences for the semifinalists were held this spring at various NASA field centers.

Semifinalists' proposals were then judged by a national team which selected the finalists. Panelists on the judging team included high school science teachers, university professors of science and engineering and representatives of NASA and U.S. aerospace corporations.

Although all winners' proposals were submitted separately, in several cases, similar proposals were declared as winners. In the experiment preparation phase of the program, it may prove advantageous for these students to work as collaborators or at least cooperate on the collection and evaluation of data.

Most student experiments will be placed in storage lockers in the mid-deck section of the Shuttle orbiter. The mid-deck placement will allow easy astronaut access to the student experiments. As much as one hour of an astronaut's time during the flight may be allocated to work on the experiment.

Assisted by a sponsor and/or a NASA consultant, the student will analyze the data returned from the experiment and prepare a final report. All scientific data from the student experiments will be in the public domain and made available from the National Space Science Data Center at NASA's Goddard Space Flight Center, Greenbelt, Md.

The 10 student winners and experiments selected for potential flight on future Space Shuttle missions are:

Harold A. Christy, Chicago, The Latin School of Chicago; "Three Dimensional Chemical Waves Formed in Microgravity by the Belousov-Zhabotinskii Reaction."

George Gerliczy, Ridgewood, N.J., Benjamin Franklin Jr. High School, Ridgewood, N.J.; "The Effects of Zero Gravity on an Amphibian Embryonic Nucleus and the Position of that Nucleus During Morphological Development after Cloning."

John M. Hendricks, Michigan City, Ind., Marquette High School, Michigan City; "Attempts to Extend Axonal Length and Filapodial Growth in Abnormal Neurons in a Microgravity Environment."

Karen L. Jarrard, Gaithersburg, Md., Montgomery Village Jr. High School, Gaithersburg; "Electric Muscle Stimulation for the Prevention of Muscle Atrophy in a Weightless Environment."

Lance G. Jeffers, Hot Springs, Ark., Mountain Pine High School, Mountain Pine, Ark.; "The Development of Bullfrog Eggs in Zero-Gravity."

Kenro Kusumui, Raleigh, N.C., North Carolina School of Science and Mathematics, Durham, N.C.; "The Adaption of Thin Layer Chromatography to a Microgravity Environment."

Jane M. McCabe, Bowie, Md., Eleanor Roosevelt High School, Greenbelt, Md.; "The Effects of Antibiotics on Bacteria in a Zero-Gravity Environment."

Emma C. Redmond, Greenwich, Conn., Greenwich Academy, Greenwich; "Osteogenesis in a Microgravity Environment."

Carla Marie Saturnelli, Cornwall-on-Hudson, N.Y., Military Academy, Cornwall-on-Hudson; "Metamorphosis of Vanessa cardui in a Microgravity Environment."

Brian L. Vlcek, Parma, Ohio, Parma Senior High School; "Inducing a Geotropic-type Reaction in Radish Roots with Chemical Stimuli."

NASA Conducts Gypsy Moth Survey on East Coast

A NASA U-2 type aircraft is photographing more than 80,000 square miles of five states and the District of Columbia in a gypsy moth study being conducted from Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, Va.

The plane — known as an ER-2 — is a larger version of the U-2 high altitude reconnaissance aircraft. Mapping the current year's damage by the gypsy moth in Maryland, New York, Pennsylvania, Virginia and West Virginia as well as the District of Columbia, the study began in late June and was completed by mid-July.

The photography is designed to identify areas defoliated by the caterpillars and to gauge the effectiveness of spraying programs involving chemical and biological insecticides.

In recent years, several million acres of hardwood forest suffered damage by the gypsy moth, according to officials with the U.S. Forest Service, which is conducting the study.

In 1981, a peak year, more than 12 million acres were defoliated, they reported.

Jerry Hoyt and Ron Williams are the two NASA Ames Research Center pilots participating in the flights. Jim Cherbonneaux is the Ames U-2 Branch Chief and was Deployment Manager for the 1984 Gypsy Moth Project. Gene Godwin is the Wallops coordinator for the project.

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Pioneer Can Make Unique Halley's Comet Observation

NASA has identified an opportunity to reorient the Pioneer spacecraft now in orbit around Venus to look at Halley's Comet in early 1986, as the comet hurtles between Venus and the sun on its 76-year tour of the solar system.

This will give the United States a unique observation of Halley's Comet, because the Pioneer Venus orbiter will be the only spacecraft in a position to observe the comet when it is most spectacular — at perihelion, the point where a comet comes nearest the sun and is most active.

Because the earth will be on the opposite side of the sun from both Venus and the comet at perihelion, direct observations from our planet will be extremely difficult. But Halley's Comet will be easily seen from the Pioneer orbiter spacecraft at Venus.

Data from Pioneer's ultraviolet spectrometer will add to the information from other observations, to provide a detailed scientific portrait of Halley's Comet, which has been observed at every passage since 87 B.C. but which won't be seen again until the year 2061.

The Pioneer orbiter was launched in 1978 to make a detailed scientific study of Venus, and the spacecraft's on-board instruments continue to study atmospheric circulation and a variety of other Venus-related phenomena. However, the Halley observation will be only the second time the orbiter will have been moved to observe a comet.

Comets are thought to resemble gigantic dirty snowballs made up of mostly dust, rocky material and water ice. As they speed toward the inner solar system, attracted by the sun's gravitational force, the intense heat of the sun vaporizes the ice and the comets grow the tail of gases and dust for which they are best known.

To observe the gases and dust emanating from Halley's Comet, NASA mission controllers must tilt the Pioneer orbiter so its ultraviolet (UV) spectrometer can point at the passing comet. The UV spectrometer, one of many scientific instruments on the orbiter, detects light in the UV region of the electromagnetic spectrum (invisible light that, among other things, causes sunburn).

Most atoms emit UV light when they're exposed to sunlight. By measuring the wavelength and intensity of the emitted light, scientists can determine which elements are present in a substance and in what amount. Data from the orbiter's UV Spectrometer will characterize the comet's composition, its water vaporization rate and its gas to dust ratio.

Comets are thought to be frozen remnants of the material that formed the sun and the planets, so such information on cometary ingredients can provide clues to the early chemical and physical history of the solar system.

Astronomers theorize that most comets reside far beyond the planets as a vast "cloud," known as Oort's Cloud, which is believed to be stocked with trillions of comets. Only a relatively few journey to the inner solar system and even fewer are captured into orbit to return again and again.

Halley's Comet comes around every 76 years, and during this passage it will reach perihelion — the point where it comes closest to the sun — on Feb. 9, 1986. There, the raging heat of the sun vaporizes the comet's ices faster than at any other time. The resulting gases, excited by the sunlight, will emit light themselves, and the dust particles dragged off the comet with the vaporized ice will reflect the sun's light, causing Halley's Comet to be at its brighest.

At this time, unfortunately, the comet will be on the far side of the sun, and direct observations from the earth will be nearly impossible. In fact, Halley's Comet won't be the visual spectacle it has been in past apparitions because of the adverse celestial geometry during its 1986 passage. Ray L. Newburn, leader of the International Halley Watch, says the 1986 appearance will be the "worst viewing for the naked eye in the last 2000 years."

But the planet Venus will be relatively close to Halley's Comet at perihelion, so the Pioneer Venus orbiter will be particularly well-placed for viewing the comet. Halley's Comet will be observed for six to eight weeks in February and March 1986.

Pulled by the same gravitational force that keeps the planets revolving in their orbits, Halley's Comet will swing past the sun at about 111,850 miles per hour. Thus, to gather data on the fast-moving comet, the Pioneer orbiter must regularly be moved to track it.

To practice making the maneuver necessary to observe Halley's Comet, mission controllers tilted the orbiter by 37 degrees in mid-April 1984 to look across the solar system at Comet Encke. The data from the Pioneer orbiter were surprising — Comet Encke was losing water at a rate approximately three times higher than expected for its distance from the sun. This suggests that the materials making up Comet Encke are not mixed together well.

For the Halley observation, members of the Pioneer Operations team will send commands for orbiter maneuvers from the Pioneer Mission Operations Center at Ames Research Center, Mountain View, Calif. To

control the Pioneer orbiter's tilt, team members will fire pulses from one of the seven small rocket motors, or thrusters, on the spacecraft.

The orbiter spins five times a minute as it travels in its orbit around Venus. By selecting the right time during each spin for the orbiter to fire the thruster, and by choosing the number, length and direction of the thruster pulses, engineers will be able to tilt the spacecraft to the desired position. For the Halley's Comet observation, the pointing of the orbiter's spin axis will be moved in small increments. The orbiter will fire a total of some 1,000 pulses each a half second long, and the entire maneuver will consume about half of the spacecraft's usable fuel reserve.

Because the UV spectrometer has a small field of view and is always rotating it will "see" only a strip of Halley's Comet during each spin. However, by tipping the orbiter so the UV spectrometer can view another area, a two-dimensional image of the entire comet can be built up, strip by strip.

The orbiter's data will be sent to scientists at the University of Colorado at Boulder. There, a team of researchers, headed by Dr. Ian Stewart, the principal investigator for the UV Spectrometer instrument on the orbiter, will analyze the data.

The Pioneer spacecraft is managed by NASA's Ames Research Center and was built by Hughes Aircraft Co. of El Segundo, Calif. The UV spectrometer was built by the University of Colorado at Boulder.

Other NASA observations of Halley's Comet include those from the Shuttle-borne Astro 1 and Spartan missions, in which a variety of UV sensitive instruments and cameras will look at the comet. NASA also plans observations from the International Cometary Explorer spacecraft, the Solar Maximum Mission and International Ultraviolet Explorer satellites as well as several sounding rockets. In addition to these remote observations, the European Space Agency's Giotto spacecraft and two spacecraft from the Soviet Union and one from Japan will make close passes by Halley's Comet about a month after perihelion. They will make in place measurements of the dust and gases emitted by Halley's Comet.

In its earlier appearances, Halley's Comet was thought to be a portent of historic events, usually unpleasant ones. It was believed to have foretold the death of Agrippa in 11 B.C., the destruction of Jerusalem in 66 A.D. and the defeat of Attila the Hun in 451. Before English astronomer Edmond Halley calculated the comet's elliptical path around the sun, in the early 1700s, many astronomers had thought comets were random celestial occurrences.

But Halley, who had studied numerous other comets, noticed that three of them — the comet he observed in 1682 and two earlier comets — followed remarkably similar paths. These three came about 76 years apart, and Halley surmised they were actually periodic appearances of the same comet. He even predicted that the comet would show up next in 1758. Halley was right, and the comet he observed now bears his name.

International Search and Rescue Program Saves 223 Lives

Eight more lives have been saved by an international satellite-aided search and rescue program, officials at NASA's Goddard Space Flight Center, Greenbelt, Md., report.

The eight rescues bring to 223 the number of lives that have been saved since the program began in September 1982, according to Fred Flatow, mission manager at the Goddard. All eight were maritime rescues.

Two of the incidents — the rescue of six fishermen in the Mediterranean Sea and the rescue of one sailor off the coast of California — occurred in February and March respectively. However, the reports were just received at Goddard.

The third incident took place in the Atlantic Ocean off the Azores on May 19, Flatow reported. A sailor was rescued when a 19-foot Canadian yacht became disabled.

In all three cases, distress signals were heard by both U.S. and Soviet satellites. They were relayed to ground stations, which dispatched rescue forces. The United States has one satellite and the Soviets have two in the program, known as COSPAS/SARSAT. COSPAS/SARSAT are Russian and American acronyms respectively for Search and Rescue Satellite-Aided Tracking.

The six fishermen in the Mediterranean had abandoned their fishing vessel on Feb. 2, after it had been wrecked by foul weather with 50-knot winds and 23-foot waves. Because of the weather, a first search plane did not locate the crew. A second plane, however, finally spotted them 40 miles from where their ship had sunk. Their lifeboat was within 4½ miles of where the Mission Control Center at Toulouse, France, had indicated it would be, a testimony to the accuracy of the satellite system.

The incident off the California coast took place March 30, Flatow reported. The 25-foot sailing ship, "Arctic Wind," encountered difficulties 60 miles

southwest of Monterey. The lone person on board had no voice communications and no survival equipment, according to Coast Guard sources, but signals from its Emergency Position-Indicating Radio Beacon (EPIRB) were picked up by the satellites. The signals were verified by overflying airliners, after which the Coast Guard Cutter Cape Hedge intercepted the vessel and towed it to San Luis Obispo.

To date, the satellite program, in which Canada, France, the United Kingdom, Norway, Sweden, Finland and Bulgaria also participate, has saved 115 persons in maritime and 107 in air emergencies. It also is responsible for saving the life of one person "on foot." That was a woman dog sled musher in Alaska who became ill on a 500-mile dog sled trek from Kotzebue to Point Barrow in April.

Space Shuttle Main Engine Testing Reaches Milestone

The Space Shuttle main engine testing program reached a major milestone recently when an engine completed a ground test demonstration, equivalent to 20 flight missions. The testing is managed by the Shuttle Projects Office at the Marshall Space Flight Center in Huntsville, Ala.

The flight life of a Shuttle engine and its components is demonstrated through a ground test program called "certification." Of the series of engines being built for the Shuttle by the Rocketdyne Division of Rockwell International, Inc., some are intended for actual flight use and some specifically for ground testing.

One of the these "test only" engines — serial no. 2010 — has been put through rigorous paces since 1981 at the National Space Technology Laboratories (NSTL) in Bay St. Louis, Miss. At NSTL, where certification and flight testing occurs, engine 2010 has accumulated a run duration of 19,900 seconds from 65 tests. It has been in test longer than any other Shuttle main engine.

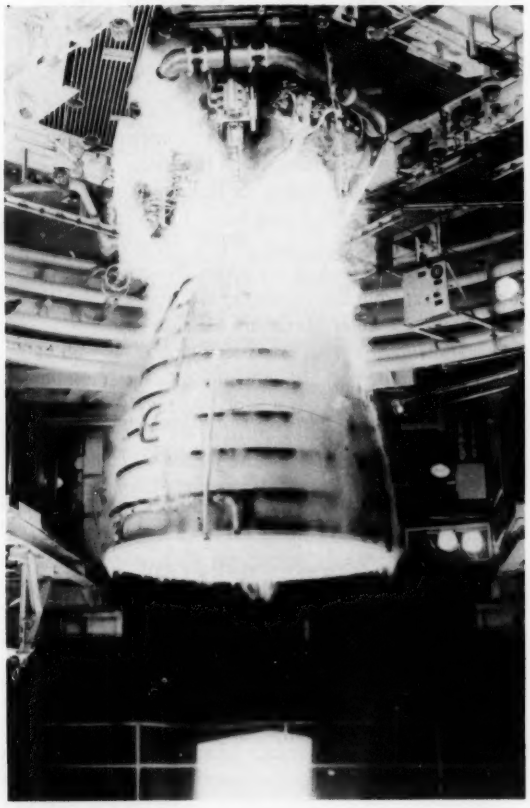
Since a Shuttle engine operates about 500 seconds during a mission, the 19,900 seconds accumulated by engine 2010 equates to about 40 flights. To provide a high degree of flight safety margin, however, NASA limits the flight life of Shuttle engines to half the lifetime demonstrated by ground testing. Thus, engine 2010 has demonstrated a flight capability of 20 missions at the 104 percent thrust level.

The main engine of the orbiters now in service were originally designed to provide thrust of 470,000 pounds, usually referred to as 100 percent of rated thrust. NASA has demonstrated, however, that the engines are capable of higher thrust levels. Since 1980, much of the ground tests have been run at 104 percent of rated thrust or higher. Engine thrust in recent flights of the Shuttle has, in fact, been at the 104 percent level, which permits heavier payloads to be carried into orbit.

While the maximum thrust level needed through 1985 is 104 percent, the space agency is preparing the engines to perform at still higher levels. Much of the testing has been at 109 percent of rated thrust, and the Shuttle is expected to be routinely flying at that level by 1986.

"The statistics from this 20-mission certification are very encouraging," said William Taylor, manager of Marshall's Flight Engine Project. "Of the 19,900 seconds, more than 14,000 were above the rated power level with 8,400 at 109 percent. We even ran the engine 780 seconds at 111 percent of rated thrust to demonstrate design margin. That gives us confidence that if one engine were to fail in flight, the Shuttle could safely rely upon the remaining two at the 109 percent level to compensate for the lost engine."

Included in the accumulated time of nearly 20,000



Engine testing at NSTL.

seconds were 30 Shuttle mission simulations based on actual flight "profiles." "To say that we ran the test based on flight profiles means that engine 2010 was run at various thrust levels to simulate actual flight condition," said Taylor. "During an actual mission, the Shuttle engines aren't run at the same levels from liftoff to orbit. It's necessary that the levels change to accommodate Shuttle structural requirements that are affected by upper atmospheric wind shear conditions. These conditions could overstress some Shuttle parts if the engine power level is not reduced — so you have to slow down, perhaps to 65 percent of rated power. After the Shuttle passes through this critical region, you can resume more powerful thrust levels."

Among the 20 flight certification statistics are seven simulated abort tests. These tests simulated a failed-engine condition and the subsequent dependence on remaining engines to run at higher thrust levels.

NASA initiated the ground test program with Rocketdyne in 1975. Marshall is responsible for the Shuttle's propulsion system, which includes the three main engines of the orbiter, the external tank and the twin solid rocket boosters.

Ames Aircraft Operations Consolidated

All NASA Ames Research Center aircraft and their operation have been transferred to the Ames Flight Operations Directorate. Martin A. Knutson, Director of Flight Operations and Site Manager of the Ames Dryden Flight Research Facility, will be responsible for all flight activities at Ames's Moffett Field location in northern California and at the Ames Dryden Flight Research Facility in southern California.

The Flight Operations Directorate office will continue to be maintained at Dryden.

One factor in the management change is continued safety of flight. Continuity of aircraft operations will be assured with all flight organizations reporting through a single management chain.

The change further serves to more fully integrate the Dryden facility into the day-to-day operations of the parent Ames Center. Ames and the former Dryden Flight Research Center, now Ames Dryden, were consolidated in 1981, a move which enhanced the capabilities of both organizations.

This continuation of the Ames-Dryden consolidation will centralize all flight operations activities including operations procedures, safety and management philosophy.

In this new role, Knutson will continue to be assisted by the present Deputy Director of Flight Operations and Deputy Ames Dryden Site Manager Theodore G. Ayers.

A new position, that of Assistant Director of Flight Operations, is being added to Knutson's staff in order to provide on-site management representation at the Ames Moffett Field location. Occupying this position is Jerry M. Deerwester, who was formerly Assistant Chief of the Airborne Missions and Applications Division.

At present, there are no plans to move any aircraft or personnel involved from either location.

Mattingly to Leave NASA for Navy Post

Astronaut Thomas K. Mattingly II (Capt., USN) has been named director, Space Program of the Naval Electronic Systems Command, Arlington, Va., effective early next year.

Mattingly joined the NASA astronaut corps in April 1966. He flew in space as command module pilot on Apollo 16, April 16-27, 1972, and as spacecraft commander for STS-4, the fourth Shuttle flight, June 27-July 4, 1982.

In other astronaut activities, he served on the astronaut support crews for the Apollo 8 and 11 missions. He was the astronaut representative for the development and testing of the Apollo spacesuit and backpack. Mattingly also served as the head of the Astronaut Office DOD Support Group.

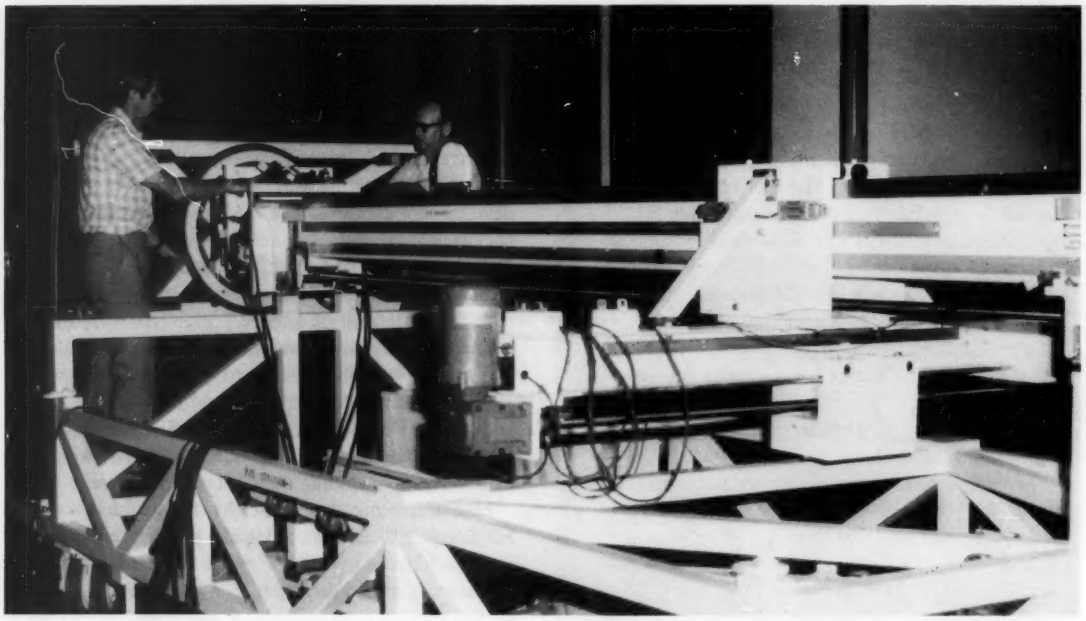
Born in Chicago on March 27, 1936, Mattingly received a bachelor of science degree from Auburn University and was commissioned as an ensign, U.S. Navy, both in 1958. Designated as a naval aviator in 1960, Captain Mattingly has served tours with VA-35 and VAH-11 in USS Saratoga and USS Franklin D. Roosevelt. He has more than 7,200 flight hours as a naval aviator, including 5,000 hours in jet aircraft.

NASA Administrator James M. Beggs said of Mattingly: "America's civil space program has profited immensely from having on tap the skill and expertise of military career people like Ken. We are proud of them all and pleased to have them on our team."

Patents for Inventions From NASA Research

The Office of General Counsel, NASA Headquarters, announces the following U.S. patents have been issued by the U.S. Patent Office and Trademark Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) & Employer	Title	Patent No.	Installation
Theodore J. Wydeven, Moshe G. Katz, National Research Council, Washington, D.C.	Method for the preparation of thin-skinned asymmetric reverse osmosis membranes and products thereof	4,456,708	ARC
Gene J. Bingham, NASA/LaRC	Shapes for rotating airfoils	4,459,083	LaRC
John A. Hrastar, NASA/GSFC	Apparatus for and method of compensating dynamic unbalance	4,458,554	GSFC
Dwight D. McSmith, James I. Richardson, NASA/LaRC	Tubing and cable cutting tool	4,458,418	LaRC
Henry G. Kosmahl, NASA/LeRC	Dielectric based submillimeter backward wave oscillator circuit	4,459,562	LeRC
Frank J. Nola, NASA/MSFC	Phase detector for three-phase power factor controller	4,459,528	MSFC
Paul J. Schlichta, Bruce A. Nerad, Caltech/JPL, Pasadena, Calif.	Glass heating panels and method for preparing the same from architectural reflective glass	4,459,470	NRO/JPL



NEW TELESCOPE HARDWARE TESTED — Moody Davis (left) and Wade Perry of the Marshall Space Flight Center, Huntsville, Ala., inspect a device to be used to install the scientific instruments and fine guidance sensors into the Hubble Space Telescope. This summer a contractor team from Lockheed Missiles and Space Co. is at Marshall to train for the installation using the device and a mockup seen in the background of the Test Laboratory's Support Systems Module. The installation of the scientific instruments and sensors is scheduled for 1985 at Lockheed facilities in Sunnyvale, Calif.

CLASS OF '84—These 17 astronaut candidates, representing the tenth group of astronaut trainees in the NASA program since the original seven Mercury astronauts were named in 1959, reported for duty at Johnson Space Center, Houston, Texas, on July 2. Bottom row (from the left): Mark C. Lee, Lloyd B. Hammond Jr., James C. Adamson, Kenneth D. Cameron, Frank L. Culbertson Jr., William M. Shepherd, Ellen L. Shulman, Michael J. McCulley, Kathryn C. Thornton and Charles L. Veach. Top row (from the left): Sidney M. Gutierrez, Mark H. Brown, John H. Casper, George D. Low, James D. Wetherbee, Marsha S. Ivins and Manley L. Carter Jr.

Wear-Proof Refrigerator Completes First Year of Operation

A wear-proof refrigeration system developed by engineers at NASA's Goddard Space Flight Center, Greenbelt, Md., and North American Philips Laboratories, Briarcliff, N.Y., has completed its first year of operation with no signs of reduced performance.

The refrigeration system, a Stirling Cycle Cryogenic Cooler, uses components which work without bearings, seals or lubricants and do not wear down from friction. The cooling system was developed for use aboard satellites but has potential applications in such fields as computers and biomedical instrumentation, food processing and robotic machinery.

The technology also could be a precursor to future commercial development of pumps, motors, compressors and other mechanical devices with longer life spans and less susceptibility to failure.

The Cryogenic Cooler has been operating at Philips Labs since March 1982 in the form of a proof-of-principle model constructed largely from commercial parts.

Operating silently at an average speed of 25 cycles per second, the system to date has run for more than 750 million cycles. The cooler generates five watts of cooling power at a temperature of 65 degrees Kelvin, when its compression heat is dissipated at 300 K.

"The model has proven the principle of the system so convincingly that we will now build a working model that could be used operationally," says Goddard's manager for the project, Dr. Allan Sherman.

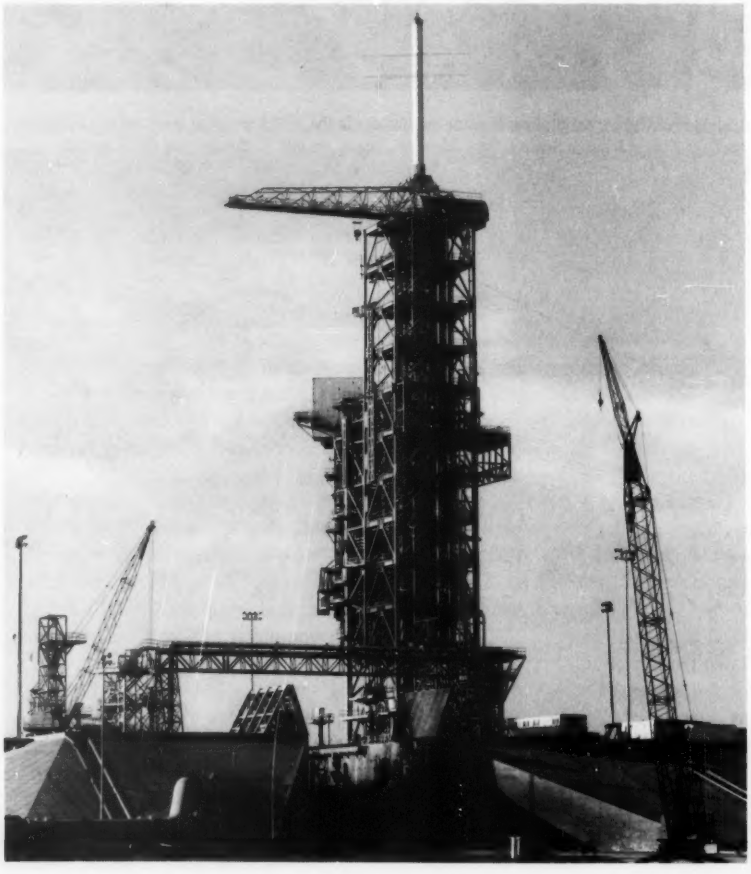
Aboard a spacecraft, the refrigerator could be used to cool the sensors of scientific instruments for five years or longer, permitting observations of faint levels of energy (such as infrared or gamma rays) from distant stars.

Equally, the refrigerator could be used to cool larger storage tanks for cryogens (low temperature coolants) aboard satellites, preventing or reducing cryogen boil-off and so extending the lifetime of the reservoir. This approach, which, for example, might be used aboard NASA's upcoming Advanced X-ray Astronomical Facility, can be compared to using a refrigerator to preserve an ice cube. In turn, the ice can be used indefinitely as a cooling source. The same technology might one day be applied aboard the Space Station to maintain a large reservoir of cryogens for refueling depleted satellites in orbit.

The cryogenic cooler also could be applied to cooling instrument sensors on earth just as in space. For example, the technology could be adapted to cooling heat-sensing devices used by geologists in deep wells or in instruments used at remote weather stations.

New NASA Publication Available

Living and Working in Space: A History of Skylab by W. David Compton and Charles D. Bensen, NASA SP-4208, has been published by the Scientific and Technical Information Branch and the NASA History Office. A chronology of the NASA Skylab program and a technical assessment of the vehicle, the publication offers readers an organizational history of NASA's efforts and successes in the Skylab era. Copies are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $20.00.



LAUNCH PAD 39-B is under construction in preparation for use as the second launch site for the Space Transportation System at Kennedy Space Center, Fla. Pad B, last used for the launch of the Apollo Soyuz Test Project in July 1975, is scheduled to become operational in January 1986.

1984 Launch Activity

Space Shuttle Launches

Date	Mission	Orbiter	Launch Site*	Remarks
Feb. 3	41-B	Challenger (OV-099)	KSC	Payload: SPAS-01A, Palapa B-2, Westar-VI; successful launch; landing at KSC, Feb 11.
April 6	41-C	Challenger (OV-099)	KSC	Payload: Solar Maximum Repair Mission; Long Duration Exposure Facility
Aug. 29	41-D	Discovery (OV-103)	KSC	Payload: LEASAT-1, Telstar 3-C, SBS-D, OAST-1; first flight of Discovery on June 26.
Oct. 1	41-G	Challenger (OV-099)	KSC	Payload: OSTA-3, ERBS
Nov. 2	51-A	Discovery (OV-103)	KSC	Payload: MSL-1, Telesat-H, GAS Bridge
Dec. 9	51-C	Discovery (OV-103)	KSC	Payload: DOD Mission

Satellite Deployments from the Shuttle

Date	Satellite	Deployment Device/** Upper Stage	Shuttle Mission	Remarks
Feb. 3	Westar-VI	PAM-D	41-B	Western Union communications; successful deployment from STS 41-B; satellite failed to achieve geosynchronous orbit.
Feb. 6	Palapa B-1	PAM-D	41-B	Indonesia communications: successful deployment from STS 41-B; satellite failed to achieve geosynchronous orbit.
April 7	LDEF	RMS	41-C	Long Duration Exposure Facility; successful deployment.
Aug. 29	SBS-D	PAM-D	41-D	Satellite Business Systems commercial communications
Aug. 30	Syncom IV-1	UUS	41-D	Hughes communications
Aug. 31	Telstar 3-C	PAM-D	41-D	AT&T communications
Oct. 1	ERBS	RMS	41-G	Earth Radiation Budget Satellite
Nov. 2	Telesat-H	PAM-D	51-A	Canadian communications

Expendable Launches

Date	Mission	Launch Vehicle	Launch Site	Remarks
March 1	Landsat 5	Delta	WSMC	National Oceanic and Atmospheric Administration; earth observation; successful launch.
June 9	Intelsat V-G	Atlas Centaur	ESMC	Intelsat international communications; satellite not in proper orbit due to Centaur stage malfunction.
Aug. 16	AMPTE	Delta	ESMC	Active Magnetospheric Particle Tracer Explorer; space physics — NASA cooperative with Germany.
Sept. 13	Galaxy-C	Delta	ESMC	Hughes commercial communications satellite.
Oct. 11	NATO-IIID	Delta	ESMC	North Atlantic Treaty Organization communications.
November	NOAA-F	Atlas-F	WSMC	National Oceanic and Atmospheric Administration weather satellite.
4th Qtr.	AF-16 (ITV-1)	Scout	WFF	U.S. Air Force.
4th Qtr.	Navy 21	Scout	WSMC	U.S. Navy.
Under assessment	Intelsat VA-B	Atlas Centaur	ESMC	Intelsat international communications.

* **Launch Sites:** ESMC — Eastern Space and Missile Center, Fla.; KSC — Kennedy Space Center, Fla.; SMR — San Marco Range, Indian Ocean; WFF — Wallops Flight Facility, Wallops Island, Va.; WSMC — Western Space and Missile Center, Vandenberg Air Force Base, Calif.

** **Separation Device/Upper Stage:** IUS — Inertial Upper Stage; PAM-D — Payload Assist Module; RMS — Remote Manipulator System; UUS — Unique Upper Stage.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

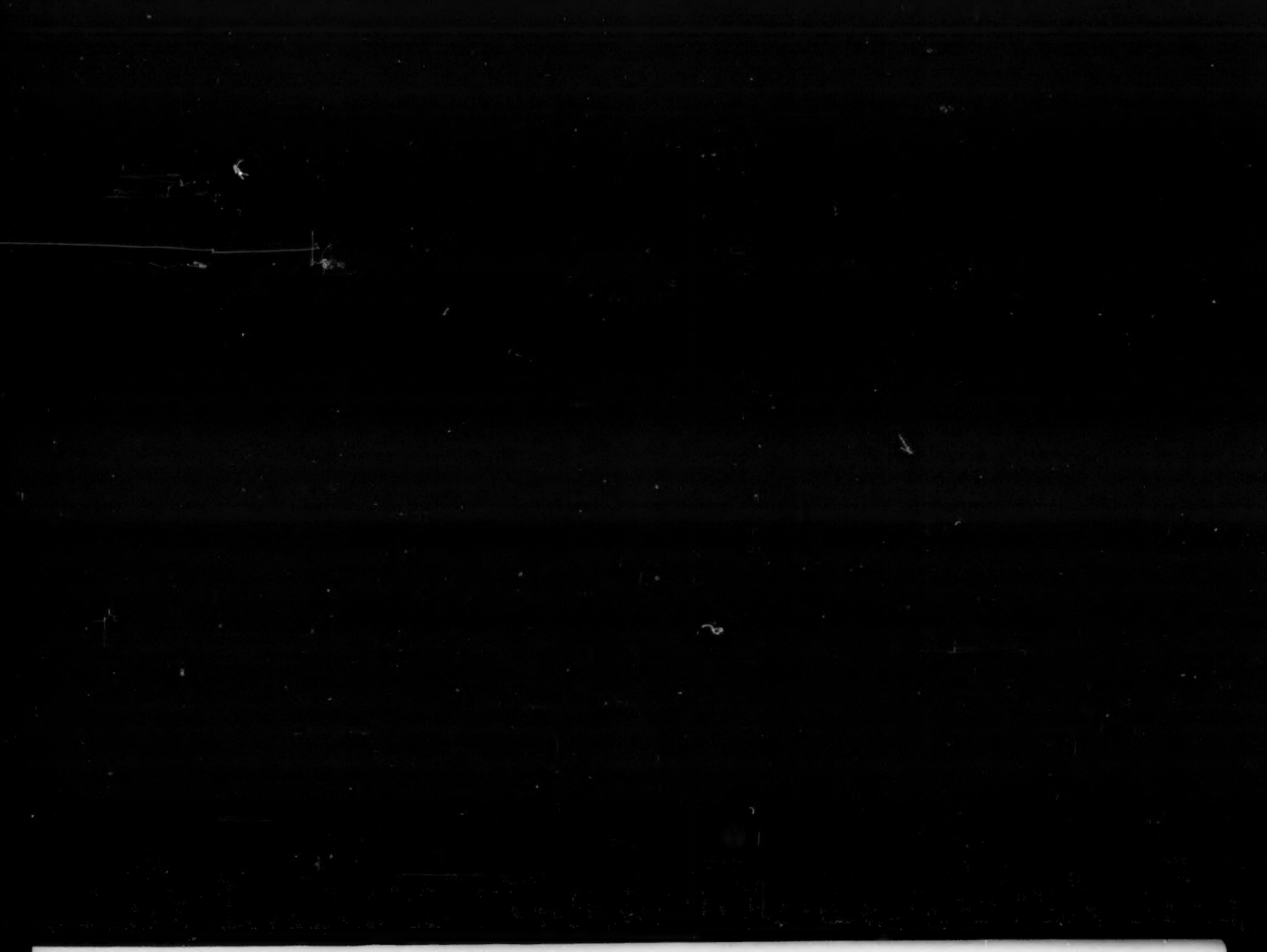
Scratch-Resistant Lenses

For many years ground and polished tempered glass has been the traditional material used for sunglass lenses. In recent years, however, the many virtues of polarized and other plastic lenses have come into sharp focus. Plastic lenses have excellent optics and better absorption of dangerous ultraviolet radiation. Further, plastic lenses are resistant to shattering, easy to shape, lightweight and more comfortable to wear than glass. A major problem with plastic lenses is their susceptibility to scratching. After a few wipes and a few wearings of sunglasses with plastic lenses a haze may appear on the lenses, greatly reducing visibility.

A similar problem to scratching of plastic lenses occurs with plastic space helmet visors. Through research, NASA's Ames Research Center, Mountain View, Calif., discoverd an abrasion resistant coating and process for polycarbonate visors. Foster Grant Corp. has manufactured over one million sunglasses utilizing the NASA coating.

Foster Grant Corp.'s Space Tech Lens, made under license from NASA, will stand up under normal wear five times longer than the most popular available plastic lenses. Additionally, the advantages of plastic lenses remain, lightness, ease of shaping, shatter resistance and almost complete absorption of ultraviolet radiation.

The coating process utilized is referred to as glow discharge or plasma polymerization. The compounds utilized in the coating process are organosilanes which are plasma polymerized and then treated for a short time with an oxygen glow discharge to increase hardness or scratch resistance.

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

NASA
National Aeronautics and Space Administration